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STATUS OF MOUNTAIN PINE BEETLE INFESTATIONS GALLATIN DISTRICT, GALLATIN NATIONAL FOREST 1973

by

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ABSTRACT

Mountain pine beetle infestations have continued at epidemic level in lodgepole pine stands since 1969 in the West Gallatin River drainage. This infestation has increased at about a 1.9:1 buildup ratio annually. Since the outbreak began in 1969, surveys indicate that approximately 22,354 merchantable size trees have been killed with an estimated volume loss of 1,061 MMBF. This is a total of about 27 percent of the merchantable lodgepole pine within areas surveyed. Additional tree mortality and volume loss have occurred, but not all infested areas were surveyed due to land exchange between Big Sky Corporation, Burlington Northern Railroad, and the Forest Service.

Operational control of felling and burning, and salvage logging of infested trees was initiated in 1971. This action did little to slow the impetus of the outbreak, because the complete infestation could not be suppressed. The outbreak is expected to continue at epidemic levels in 1974, with an increase in the number of infested trees. A cooperative administrative study between the Northern Region and Intermountain Forest and Range Experiment Station is planned in fiscal year 1975 to determine if silvicultural methods can be used to control mountain pine beetle in mature and overmature overstocked lodgepole pine stands on the Gallatin National Forest.

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INTRODUCTION

Mountain pine beetle, *Dendroctonus ponderosae* Hopk., infestations in the West Gallatin River drainage began in mature and overmature stands in 1969 on lands owned by Burlington Northern Railroad, Big Sky Corporation, private individuals, and the U.S. Forest Service.

An operational survey conducted in 1970 showed that a total of 3,796 trees were killed by the beetle in 1969, and 6,257 trees were killed in 1970 on approximately 1,314 acres. 1/ Infestations in 1970 appeared to be localized in a few drainages between the West Fork and Sheep Rock near Squaw Creek Ranger Station. In 1971, the outbreak began to expand, and new infestations were detected both in 1971 and 1972 in additional areas between these two locations.

Because of the land exchange which occurred between Big Sky Corporation, Burlington Northern Railroad, private landowners, and the U.S. Forest Service during the development of Big Sky Recreation Area, many infested areas surveyed in 1970, particularly in the West Fork, have not been surveyed since. These areas contain epidemic mountain pine beetle populations over considerable acreage.

Direct control, which consisted of felling and burning infested trees in Hell Roaring and Logger Creek drainages, and logging in Swan Creek campground had little effect, if any, in reducing beetle populations (McGregor and Dewey 1971). Felling and burning of infested trees was also done around summer houses at Tamphrey and Cascade Creeks on a yearly maintenance basis in 1971 and 1972.

An operational survey in 1972 showed infested trees occurred in both Logger and Hellroaring Creek drainages despite control efforts, and infestation also spread to many adjacent additional stands. The 1972 survey showed that about 4,661 trees were killed with a volume loss of 362,396 board feet on about 558 acres. This made a total of 10,844 trees that were killed from 1970-72 on all areas surveyed with a volume loss totaling 797,802 board feet of merchantable timber (McGregor 1973).

Since the control project in 1971, suppression has been on a relatively small scale in high use areas such as campgrounds and around summer home sites.

In late 1973, the Montana Woodland Council made a request to the State Forester asking that the outbreak in the West Gallatin Canyon be declared a Zone of Infestation. By doing this, it is the State Forester's

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1/ 5240 Memorandum, Division of State and Private Forestry files, USFS, Missoula, Montana, April 1971.

prerogative to do direct control on all lands other than Federal [2/] in the Gallatin Canyon. Prior to the State Forester declaring a Zone of Infestation, it was of prime importance to know the current status of the mountain pine beetle in the West Gallatin River drainage. A survey was conducted to determine the current number of attacks, volume loss, and the residual green stand on National Forest lands (Fig. 1). Results of the 1974 survey are reported here.

METHODS

To determine number of trees infested, volume loss, and residual green stand, a variable plot cruise was conducted during January 1974. Plots were located at 5-chain intervals on lines 5 chains apart. Wedge prisms (10 factor) were used to determine trees to be tallied in each plot. All trees 5 inches d.b.h. and larger occurring in each variable plot were recorded by species, diameter at breast height (d.b.h.), and total height for volume estimates. Then trees were classified into one of the following four tree classes:

0 - Green - uninfested

1 - 1973 attack; pitch tubes, brood present

2 - 1972 attack; red foliage, brood emerged

3 - Attacked in 1971 or prior; majority of needles dropped.

Data were analyzed using a modified Region 1 ADP sale cruise program which provides estimates of the number of infested trees, volume loss by year, and residual green stand.

RESULTS

Estimated tree mortality and volume loss data are shown in Tables 1 and 2. Since 1969, 22,354 trees have been killed, containing a merchantable volume of 1,061,772 board feet.

Within areas surveyed, 4 percent of the lodgepole pine stand were killed in 1970, 5 percent in 1971, 7 percent in 1972, and 11 percent in 1973.

In 1973, 66 percent of the trees killed were 10 inches d.b.h. and larger in size; 87 percent in 1972, and 78 percent in 1971. Of the remaining green lodgepole pine, 52 percent of the trees are 10 inches d.b.h. and larger in size.

2/ Memorandum, Montana Division of Forestry, 1973.

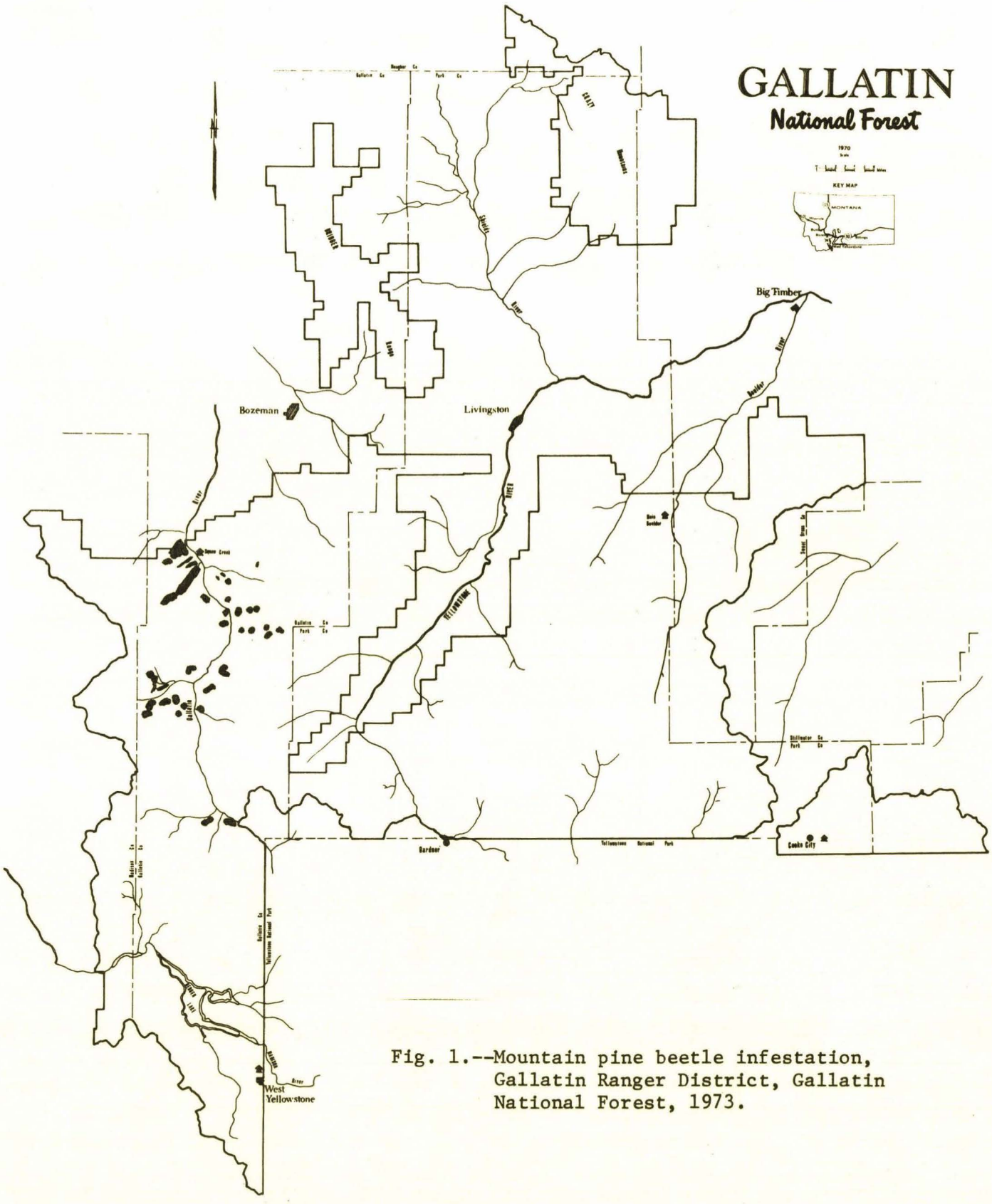

Fig. 1.--Mountain pine beetle infestation, Gallatin Ranger District, Gallatin National Forest, 1973.

Table 1.--Estimated tree mortality and volume loss, Gallatin Ranger District, Gallatin National Forest, 1969-73.

Area Surveyed	Acres surveyed by year					Infested trees/acre by year					Total trees killed by year				
	1969	1970	1971	1972	1973	1969	1970	1971	1972	1973	1969	1970	1971	1972	1973
Logger Creek		138		45	45	3.4	19.0	11.8	6.5	25.5	469	2617	237	275	1147
Hell Roaring Creek		369		260	369	3.0	4.5	6.4	10.8	10.3	788	1670	1129	2797	2671
West Creek					5	-	-	17.1	10.1	0	-	-	88	51	0
Smith Creek					15	0	0	2.5	0	0	0	0	38	0	0
French Creek					12	-	-	-	0	0	-	-	-	0	0
Mica Creek					32	-	-	0	0	4.6	-	-	0	0	147
Portal Creek		30			10	0	0	17.9	23.4	1.8	0	0	179	234	18
Tamphrey Creek				40	35	-	0.9	0.9	1.1	0	-	38	73	55	0
Sagebrush Point					10	-	-	2.9	0	0	-	-	29	0	0
Cascade Creek				20	10	-	2.0	1.0	2.6	1.6	-	51	19	25	16
Lime Creek					5	-	-	11.3	0	0	-	-	57	0	0
Old R.S.					5	-	-	0	3.1	37.4	-	-	0	25	300
Park Boy					8	-	-	22.9	0	1.5	-	-	114	0	8
Taylor Fork					5	-	-	0	0	0	-	-	0	0	0
Porcupine					10	-	-	4.6	0.6	0	-	-	23	3	0
Upper Portal				35	5	0	0	22.9	11.9	7.0	-	-	344	178	105
Greek Creek				30	10	-	-	8.3	7.0	8.8	0	10	249	70	88
Dudley Creek		20			10	16.5	5.7	0	1.9	0	330	115	0	19	0
West Fork		735				3.0	2.5	-	-	-	2209	1842	-	-	-
Swan Creek		22		25	22	0	0.6	0	0.6	0	0	13	0	15	0
Squaw Creek				45	45	-	0.9	1.1	0.3	0	-	40	51	14	0
Indian Ridge				58	58	-	20.8	1.2	23.4	-	-	1204	70	1354	0
Total or average		1314		958	726	22.5	56.9	132.8	103.3	98.5	3796	7600	2700	3758	4500
Average d.b.h.							10.7	12.5	12.5	11.0				Grand Total	22354

Table 2.--Estimated volume loss caused by mountain pine beetle, Gallatin Ranger District, Gallatin National Forest, 1970-73.

Area surveyed	Infested vol./acre (Bd. ft.)					Total volume loss (Bd. ft.)				
	1969	1970	1971	1972	1973	1969	1970	1971	1972	1973
Logger Creek	0	546	314	324	1,563	0	25,390	14,116	14,567	70,337
Hell Roaring Cr.	0	302	379	402	741	0	78,573	98,501	104,563	192,565
West Creek	-	-	830	1,307	0	-	-	4,150	6,535	0
Smith Creek	0	0	308	0	0	0	0	4,616	0	0
French Creek	-	-	-	0	0	-	-	-	0	0
Mica Creek	-	-	0	0	312	-	-	0	0	9,991
Portal Creek	0	0	2,565	3,239	404	0	0	25,648	32,392	4,035
Tamphrey Cr.	-	42	31	151	0	-	1,665	1,095	5,285	0
Sagebrush Pt.	-	-	90	0	0	-	-	896	0	0
Cascade Cr.	-	164	139	215	531	-	3,289	2,784	2,153	5,312
Lime Creek	-	-	488	0	0	-	-	2,442	0	0
Old R.S.	-	-	0	350	1,989	-	-	0	2,799	15,911
Park Boy	-	-	1,687	0	550	-	-	8,436	0	2,748
Taylor Fk.	-	-	0	0	0	-	-	0	0	0
Porcupine	-	-	286	366	0	-	-	1,428	1,832	0
Upper Portal	0	54	1,644	909	215	0	1,888	24,665	13,633	9,222
Greek Cr.	-	-	1,011	1,494	1,638	-	-	30,319	14,942	16,383
Dudley Creek	-	-	0	274	0	-	-	0	2,741	0
West Fork			-	-	-				-	-
Swan Creek	-	-	0	26	0				646	
Squaw Creek	-	148	193	43	0	-	6,663	7,804	1,949	0
Indian Ridge	-	1,251	118	1,837	0	-	72,549	6,860	106,532	-
Total or average						-	189,982	234,687	310,599	326,504

Grand Total 1,061,772

A breakdown of tree mortality by diameter classes is shown in table 3.

Table 3.--Estimated number of lodgepole pine killed by size class, West Gallatin River drainage, Gallatin National Forest, 1971-1973 (based on 503 acres).

	D.b.h. - inches														
	7	8	9	10	11	12	13	14	15	16	17	18	20-22	24	28
Remaining green trees	181	127	133	198	79	150	27	55	7	38	4	72	12	1	0
1973	10	15	18	21	12	16	5	16	0	10	0	1	3	0	0
1972	1	3	5	10	1	9	9	16	0	7	0	6	3	0	1
1971	7	3	7	16	3	16	2	9	2	5	1	6	0	1	0

Percent tree mortality by diameter classes is shown in table 4.

Table 4.--Percent lodgepole pine killed by the mountain pine beetle, West Gallatin River Drainage, Gallatin National Forest, 1971-1973 (based on 503 acres).

	D.b.h. - inches															
Code	7	8	9	10	11	12	13	14	15	16	17	18	20-22	24	28	Total
Remaining green trees	15.9	20.0	11.7	17.4	6.9	13.2	2.3	4.8	0.6	3.3	0.3	1.9	1.0	0.8	0	99.3
1973	7.8	11.8	14.1	16.5	9.4	12.5	3.9	12.5	0	7.8	0	0.7	2.3	0	0	99.3
1972	1.3	4.1	6.9	13.8	2.7	12.5	12.5	22.2	0	9.7	0	8.3	4.1	0	1.3	99.4
1971	8.7	3.7	8.7	20.0	3.7	22.5	2.5	11.2	2.5	6.2	1.2	7.5	0	1.2	0	99.6

The coniferous stand surveyed is 77 percent lodgepole pine, *Pinus contorta* Douglas, 11 percent Engelmann spruce, *Picea engelmanni* Parry, 10 percent Douglas-fir, *Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco, and 3 percent subalpine fir, *Abies lasiocarpa* (Hook.) Nutt. Habitat type varies from *Abies lasiocarpa/Vaccinium scoparium* to *Pseudotsugae menziesii/Symphoricarpos albus*. Elevation within the infestation ranges from 5,350 to about 7,000 feet.

A total of 22 areas including 503 acres were surveyed. About one-half of the infested area surveyed in 1970 was resurveyed in 1972-1973. This was primarily because a considerable portion of the infestation occurred

in the West Fork drainage, and this came under the land exchange between Big Sky Corporation, Burlington Northern Railroad, and the Forest Service.

In 1971, a survey of 425 acres of private lands in the West Gallatin River drainage showed an average of 8.3 infested trees/acre in 1971, 2.4 in 1970, and 3.1 in 1969. A total of 5,886 trees were killed, with a volume loss of 442,310 board feet of merchantable timber. In this area, the average d.b.h. of attacked trees was 11 inches in 1970 and 1971, and 10 inches in 1969. Infestation on private land has not been resurveyed since 1971 (Kohler 1971).

DISCUSSION

The current mountain pine beetle infestation has caused a considerable loss of merchantable lodgepole pine in the West Gallatin River drainage since 1969. Trend of the outbreak inclined steadily from 1969 to 1973 (Fig. 2).

Survey data shows that yearly buildup ratios of new to old killed trees was 2:1 from 1969 to 1970, 2.7:1 from 1971 to 1972, and 1.1:1 from 1972 to 1973. This is an average buildup ratio of 1.9:1 during the 4-year infestation period. Parker (1973) determined from surveys in the Yellowstone National Park infestation that the increase in tree mortality from one year to the next caused by mountain pine beetle did not exceed 2.6:1.

With the available lodgepole pine 12 inches d.b.h. and larger, we expect the outbreak could continue at its present epidemic level and probably continue to increase. It has been shown that during the course of a mountain pine beetle outbreak, the larger diameter trees are infested and killed first each year, as well as over the life of the infestation (Cole and Amman 1969). They also found that large trees (12 inches d.b.h.+) produce more beetles per unit area of bark and more per tree due to their greater surface area.

Although some stands are highly mixed, it has been shown that in some stands where 35.9 percent trees of other species occurred, these stands were as susceptible as those having less than 10 percent trees of other species (Amman and Baker 1972).

We do not believe that elevation within the infestation is a limiting factor as far as having an adverse effect on beetle biology. Amman and Baker (1972) found that lodgepole pine survival was greater at elevations above 8,900 feet because more than 1 year was required for the mountain pine beetle to complete a generation and that this can be a limiting factor as far as number of trees attacked from one year to the next.

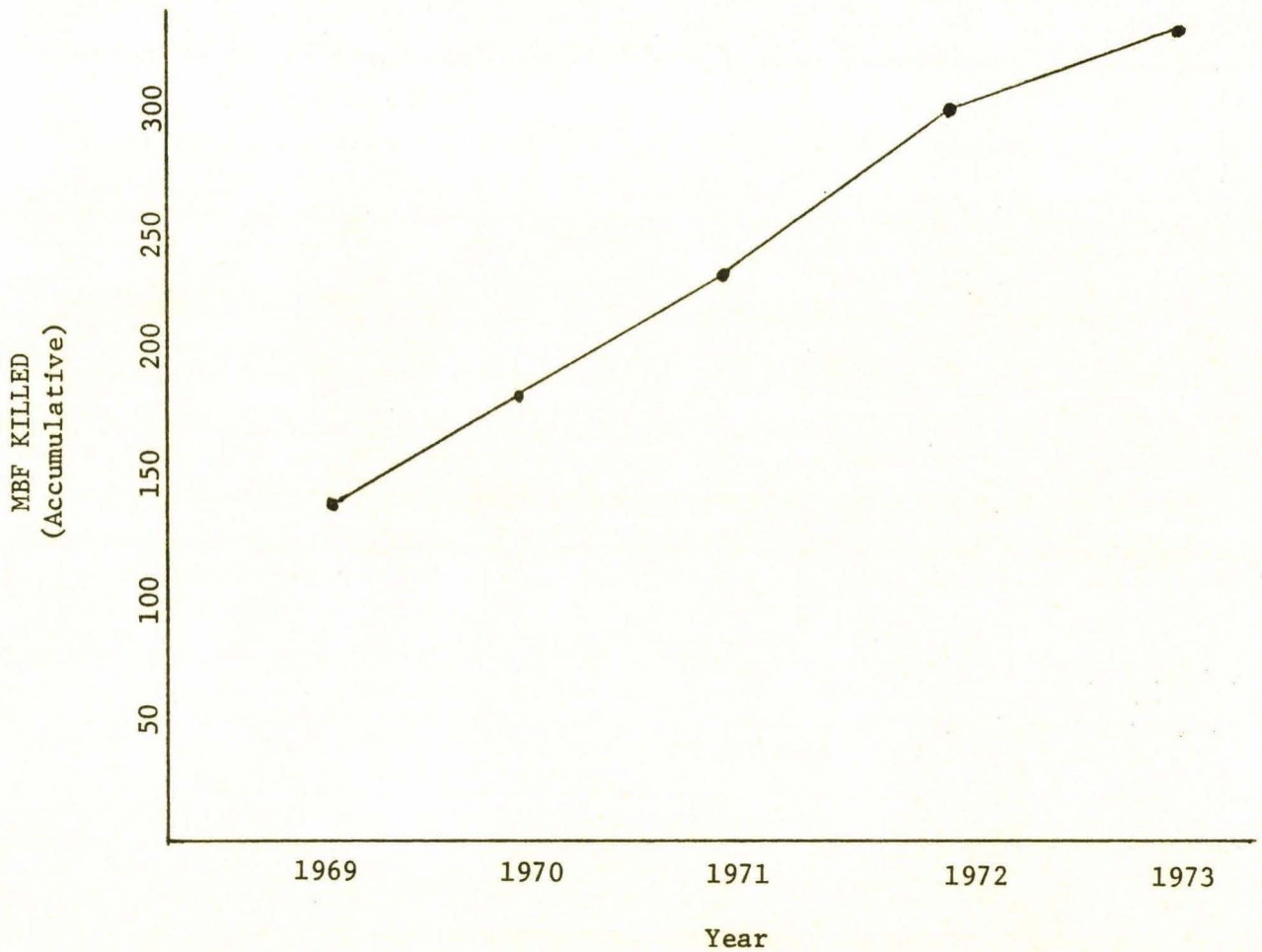

Figure 2.--Trend of mountain pine beetle in lodgepole pine West Gallatin River Drainage.

Greatest number of trees killed has been in the Hell Roaring Creek drainage, followed by Logger Creek and Indian Ridge. Had the adjacent private land been surveyed in 1973, these areas would probably have shown as many or more infested trees as the Hell Roaring Creek drainage.

Biological data indicates an increasing trend during 1973. The infestation is spreading rapidly and new epicenters are developing in mature and overmature stands yearly.

RECOMMENDATIONS

For the areas surveyed, it appears that the mountain pine beetle is causing tree loss which will eventually endanger a large part of the merchantable lodgepole pine stand in the West Gallatin River drainage.

Food is probably the most significant limiting regulatory factor for survival of mountain pine beetle broods (Amman 1969); and stand density and elevation are the next strongest limiting factors. Although phloem-tree diameter relation is variable, the larger diameter trees generally contain the thickest phloem, and small diameter trees the thinnest phloem. Large trees usually produce more beetles per unit area of bark than do small trees. Only infested trees 12 inches d.b.h. and greater produce more beetles than they absorb (Cole and Amman 1969).

Since large diameter trees are usually killed first, as well as during the life of the outbreak, the problem then is to manage, or alter, these stands of lodgepole pine in such a way as to reduce and/or prohibit potential buildup of epidemic populations of mountain pine beetle (Cole et al. 1974).

Management of beetle infested areas is complicated by the intermingled land pattern. Ideally, to combat this outbreak, the entire area should be managed to improve stand vigor. This means all landowners should cooperate. Because this cannot be done, Cole et al. (1974) offer the following alternatives as an administrative study:

The field experiment will be conducted on the Hebgen Lake and Gallatin Ranger Districts. Guidelines for stand selection will be based on less than five infested trees per acre within and around such stands.

The primary objective of this experiment is to test and evaluate harvesting intensities structured to reduce and/or prohibit lodgepole pine losses due to mountain pine beetle.

Secondary objectives are to determine (1) the change in a multiplicative probability of occurrence of phloem-diameter relationships and (2) evaluate this probability as an indicator of potential epidemic beetle populations and resultant tree loss.

This test will be implemented by establishing five 40-acre lodgepole pine plots in stands on the basis that they have two to five infested trees per acre.

Each stand will receive one of the following harvesting plans prior to beetle flight in 1975:

1. Remove the infested trees and all green trees above 12 inches d.b.h. regardless of phloem depth.

2. Remove the infested trees and all green trees above 10 inches d.b.h. regardless of phloem depth.

3. Remove the infested trees and all green trees above 8 inches d.b.h. regardless of phloem depth.

4. Remove the infested trees and all green trees with 0.08 inch phloem depth regardless of diameter--minimum diameter to be 8 inches d.b.h.

5. Remove no trees--control plot.

Sampling prior to cutting and after are described in the prospectus for the field experiment, "Harvesting strategies for management of the mountain pine beetle in lodgepole pine stands in the Rocky Mountains." A detailed plan of this study will be presented to the Gallatin National Forest during May 1974.

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